REMARKS

By means of this Preliminary Amendment, the Applicant has canceled dependent claims 15, 17, 35, and 37, which are being prosecuted in the parent application (Serial No. 10/038,111), of this Rule 53(b) continuation patent application. Accordingly, claims 1-14, 16, 18-34, 36, and 38-42 are pending in this application.

By means of this Preliminary Amendment, the Applicant has amended independent claims 1, 21, and 40-42 to define with greater particularity the claimed capacitive sensing circuit according to the present invention. More specifically, independent claims 1, 21 and 40-41 have been amended to recite that:

(i) the microcontroller has at least one I/O pin capable of functioning in both an INPUT mode and an OUTPUT mode;

(ii) that the conductive sense element is charged by causing a selected voltage to be placed on the I/O pin by setting the I/O pin to the OUTPUT mode in a high state; and

(iii) setting the I/O pin to the INPUT mode, which causes the conductive sense element to discharge through the single resistance element, and measuring the voltage at the I/O pin.

The Applicant has pointed out that an objective of the instant application is to provide simple, reliable, low-cost capacitive sensing systems and methods that are suitable for use in a wide range of toys, robotic devices, or other objects. This is achieved by the simple capacitive sensing system depicted in Figure 1A and described in the specification that uses a conventional, low cost microcontroller, e.g., a complementary metal-oxide semiconductor, of the type typically found in interactive toys or other "smart" devices. The application further teaches that such a microcontroller must have at least one I/O pin capable of functioning as an input and output, i.e., in an input mode and an output mode. Use of the I/O pin of an existing microcontroller in this manner minimizes the complexity and cost of the circuitry comprising the capacitive sensing system.

SECTION §102(b) REJECTION:

Considering first the rejection of claims 1-3, 5, 16, 20, 21-23, 25, 36, and 40 under 35 USC 102(b) as being anticipated by West et al. (U.S. Patent No. 5,831,597) (hereinafter "the '597 patent"), the Applicant respectfully submits that independent claims 1, 21 and 40, and claims depending therefrom, as amended, are not anticipated by nor obvious in view of the '597 patent.

As noted above, the claimed subject matter of the instant invention comprises a microcontroller that includes an I/O pin that functions in both an input mode and an output mode. The '597 patent, in contrast, describes an electronic circuit for capacitive touch sensors (see FIG. 4) that is complex and includes a multiplicity of separate and distinct circuits and components, which includes a multiplicity of separate and distinct microprocessor pins for charging, discharging, and measuring the voltage of a capacitive touch sensor.

In particular, the '597 patent teaches the use of:

(i) a charge line (180) that is used to charge any particular capacitive touch sensor, e.g., capacitive touch sensor (58);

(ii) a column line (112) for discharging the capacitive touch sensor (58); and

(iii) a detection line (110) for determining when the charge on the capacitive touch sensor (58) reaches a threshold voltage during the discharge process.

The '597 patent teaches that the charge line (180) includes a charge pin (12) of the microprocessor (80), two diodes (182, 184), two resistive elements (114, 116), and the capacitive touch sensor (58) connected to a supply voltage (Vcc) as illustrated in FIG. 4 - see also Col. 5, lines 8-13. The '597 patent further teaches that the detection line (110), which is connected to the charge line (180) between the diodes (182, 184), is connected to a pin (8) of the microprocessor (80). And, the '597 patent teaches that the column line (112) is connected to the pin (15) of the microprocessor (80) and the junction between resistive elements (114, 116).

Based upon the foregoing, the Applicant respectfully submits that the '597 patent does not teach or suggest a capacitive sensing system that utilizes a single I/O pin that is capable of functioning in both an INPUT and OUTPUT mode as recited in independent claims 1, 21 and 40, as amended, of the instant application that is utilized for charging, discharging, and measuring the voltage of a conductive sense element. In contradistinction, the '597 patent specifically teaches a circuit (FIG. 4) wherein the microprocessor (80) utilizes separate and distinct pins, i.e., pin (12), pin (15), and pin (10) for charging, discharging, and measuring the voltage of a capacitive touch sensor (58).

Accordingly, based upon the foregoing discussion, the Applicant respectfully submits that independent claims 1, 21, and 40, as amended, and claims depending therefrom, i.e., claims 2-20 and 22-39, respectively, are not anticipated by nor obvious in view of, the disclosure of the '597 patent (West et al.). Therefore, the Examiner is

respectfully requested to reconsider the patentability of independent claims 1, 21, and 40, and claims depending therefrom, in view of the foregoing discussion.

FIRST SECTION §103(a) REJECTION:

Considering next the rejection of claims 4 and 24 under 35 USC §103(a) as being unpatentable over the '597 patent in view of Aggarwal (U.S. Patent No. 3,569,727) (hereinafter "the '727 patent"), the Applicants respectfully submit that claims 4 and 24, which depend from independent claims 1 and 21, respectively, as amended, are patentably distinguishable over the cited references of record for the reasons presented in the preceding paragraphs.

Furthermore, the Applicant respectfully submits that the disclosure of the '727 patent regarding the use of "capacitor discharge pulses" is not similar to the use of "discharge pulses" as described and claimed in the instant application. The '727 patent discloses that the timing means described at Col. 2, lines 59-67, is operative to open a switch 25, wherein an ignition system is automatically disabled after the ignition system has been operated for approximately a "predetermined interval" of time. With respect to this "predetermined interval", the '727 patent teaches, at Col. 3, lines 7-12, that "after a number of pulses, which may be at least approximately determined", discharge of a condenser (34) will ultimately cause the opening of the contacts of switch (25).

In essence, therefore, the '727 patent teaches the use of known capacitive elements to provide a predetermined number of pulses, i.e., a predetermined time interval, after which the ignition system is automatically disabled. In contrast, the number of discharge pulses 'measured' in dependent claims 6 and 24 define an unknown quantity, i.e., time, for the sense element to decline to a value below a threshold value. However, once this time is ascertained by measuring the number of pulses, the effective capacitance, which is another unknown quantity defined by the conductive sense element and a first object in contact or proximity therewith, can be determined using a known equation.

Moreover, the Applicant respectfully controverts the Examiner's assertion that it would have been obvious to one skilled in the art to modify the disclosure of the '597 patent by the teachings of the '727 patent. As noted above, the '727 patent teaches the use of a known capacitance so as to generate a known number of pulses to temporarily disable an ignition system. The '597 patent, in contrast, is operative to determine (by measuring) discharge time of a capacitive touch sensor, and to use this discharge time, in conjunction with the known resistance of a discharge resistor, to determine the capacitance of the capacitive touch sensor. Basically, the '727 patent teaches use of discharge pulses in a different way for a different purpose, and accordingly one skilled in

the art would not have found it obvious to modify the invention of the '597 patent by the teachings of the '727 patent.

Based upon the foregoing discussion, the Applicant respectfully submits that claims 4 and 24 are patentably distinguishable over the cited references of record. Therefore, the Examiner is respectfully requested to reconsider the patentability of claims 4 and 24 in view of the foregoing discussion.

SECOND SECTION §103(a) REJECTION:

Considering next the rejection of claims 6-14, 18-19, 26-34, and 38-39 under 35 USC §103(a) as being unpatentable over the '597 patent in view of Tagg et al. (U.S. Patent Publication No. 2003/0067451 A1 (hereinafter "the '451 publication"), the Applicants respectfully submit that claims 6-14 and 18-19, and 26-34 and 38-39, which depend from independent claims 1 and 21, respectively, as amended, are patentably distinguishable over the cited references of record for the reasons presented above in connection with the 102(b) rejection.

In addition, the Applicant respectfully submits that the disclosure of the '451 publication does not teach or suggest "resolution enhancement", "automatic calibration" or "continuous calibration", "noise reduction", and/or "pattern recognition using virtual sensors" as described and claimed in the instant application.

Cited paragraphs [0037]-[0040], [0127] of the '451 publication refer to a means for recognizing the time profile of a capacitance change, detect a snap effect in the capacitance change time profile, for enhancing the snap effect portion of a capacitance profile, for correcting the base line of the profile, and for correcting the maximum amplitude of the profile. As disclosed in the specification at paragraph [0173], the snap effect is the dramatic increase in capacitance over time as the finger approaches the capacitive touch detectors due to the dielectric discontinuity at the glass. Basically, this describes a method of capturing a time profile of capacitance change, i.e., the dC/dT touch-down detection scheme, as an object (e.g., a finger) approaches and touches a capacitive touch sensor.

The Applicant submits, however, that foregoing disclosure is not relevant to enhancing or improving the resolution as described and claimed in the instant application. The cited disclosure does not teach or suggest the use of an iterative timing loop to improve resolution as described and claimed in the instant application. Nor does the cited disclosure teach or suggest shifting the starting point of the iterative timing loop by one clock cycle in each direction. Further, the cited disclosure does not teach or suggest

utilizing multiple measurements of discharge time that have been time-shifted to improve resolution. Finally, the cited disclosure does not teach or suggest the averaging of such multiple measurements to obtain a 1T (one clock cycle) resolution for discharge measurements (see also next paragraph).

Paragraph [0127] describes the use of averages in a proportional calculation. However, referring to the immediately preceding paragraphs, i.e., paragraph [0125]-[0126], this disclosure is a teaching regarding the use of averages to define linear interpolation for an orthogonal grid, i.e., the determination of the X-Y position of a finger in the context of a two-dimensional plane of capacitive touch sensors. This disclosure has no relevance with respect to the averaging of multiple, time-shifted measurements of discharge time to yield an effective increase in the resolution of the measurement of discharge time as described and claimed in the instant application.

Based upon the foregoing discussion, the Applicant respectfully submits that the cited disclosure of the '451 publication does not teach or suggest the averaging of multiple, time-shifted measurements of discharge time to yield an effective increase in resolution of discharge time measurements.

The Applicant respectfully submits that the citing of paragraph [0047] for the proposition that the '451 publication teaches or suggests automatic or continuous calibration as described and claimed in the instant application is inapposite. Referring to the immediately preceding paragraph, i.e., paragraph [0046], it can be seen that the reference to "self-calibrating" is in the context of interpolating the mean "position of touch", i.e., the position of the finger in contact with an orthogonal grid of sensors when the contact position is not coincident with a sensor position, i.e., between sensors. Such disclosure does not teach or suggest an automatic or continuous calibration scheme as described and claimed in the instant application wherein a first detected stable voltage value is set as an initial voltage calibration value, which is then incremented at a fixed interval, and continuously updated whenever a lower stable voltage is detected.

Based upon the preceding discussion, the Applicant respectfully submits that the cited disclosure of the '451 publication does not teach or suggest an automatic or continuous calibration using stable voltage values detected by the microcontroller.

Finally, the Applicant respectfully submits that the cited reference paragraph, i.e., paragraph [0041], which refers to providing an adaptive pattern match to a time profile of capacitance change indicative of a touch to be detected, does not teach or suggest "pattern recognition" as described and claimed in the instant application. The cited paragraph is further clarified in paragraphs [0201]-[0211] wherein the disclosure is directed to

determining the position of finger at a moment in time using linear interpolation with respect to orthogonal capacitive zones (see FIGS. 26-27). Paragraph [0041] of the '451 publication does not teach or suggest that a controller (104) or control means (106) is operative to implement one or more software applications to process signals generated by the orthogonal capacitive zones to detect one or more specific patterns of contact or proximity. In point of fact, the '451 publication does not teach or suggest the use of capacitive touch detectors other than in the single manner of an object such as a finger approaching and touching such capacitive touch detectors, i.e., the '451 publication does not teach or suggest the detection of multiple patterns of proximity or contact.

The present invention, in contrast, describes and claims "pattern recognition" wherein the capacitive sensing system of the present invention can detect selected patterns of contact or proximity, e.g., play. These "play patterns" or selected patterns of contact/proximity are described in the specification at pages 16 through 19 and include touch, proximity, hold, activity, slap, rhythm, petting, sequencing (stroking contacts in different directions), and tickle. Individual "play patterns" are detected using signals generated by the conductive sense element (140), which are processed by the microcontroller (110) implementing a specific one of a plurality of software applications (see FIG. 3 of the instant application which illustrates the plurality software applications for detecting specific patterns of play expressly described in the specification). In essence, the implementation of any one of the plurality of software applications by the microcontroller (110) to process the signals generated by the conductive sense element (140) to detect a particular pattern of contact or proximity transforms the conductive sense element (140) into a "virtual sensor" with respect to such particular pattern of contact or proximity, as described and claimed in the instant application.

Based upon the preceding discussion, the Applicant respectfully submits that the cited disclosure of the '451 publication does not teach or suggest the processing of signals generated by the conductive sense element by the microcontroller implementing one or more specific software applications to detect one or more patterns of contact or proximity.

Based upon the foregoing discussions, the Applicant respectfully submits that the disclosure of the '451 publication does not teach or suggest the subject matter of claims 6-14, 18-19, 26-34, and 38-39 of the instant application, i.e., claims 6-14, 18-19, 26-34, and 38-39 are patentably distinguishable over the disclosure of the '451 publication.

THIRD SECTION §103(a) REJECTION:

Considering next the rejection of independent claim 41 under 35 USC §103(a) as being unpatentable over the '597 patent in view of Herbert (U.S. Patent No. 5,777,597) (hereinafter "the '597 patent"), the Applicants respectfully submit that independent claim 41, as amended, is patentably distinguishable over the cited references of record for the reasons presented above in connection with the 102(b) rejection. Accordingly, the Examiner is therefore requested to reconsider the patentability of independent claim 41.

FOURTH SECTION §103(a) REJECTION:

Finally, considering the rejection of claim 42 under 35 USC §103(a) as being unpatentable over the '597 patent in view of Dickinson et al. (U.S. Patent No. 6,049,620) (hereinafter "the '620 patent"), the Applicants respectfully submit that independent claim 42, as amended, is patentably distinguishable over the cited references of record for the reasons presented above in connection with the 102(b) rejection.

Furthermore, the Applicant respectfully submits that the disclosure of the '620 patent does not teach or suggest the non-contact object identification system of claim 42 wherein at least two conductive sense elements are disposed to form a binary-coded identification pattern and a non-contact object has a corresponding binary-coded identification pattern and wherein the object identification system is operative to detect and identify the binary-coded object when such binary-coded object is aligned with the binary-coded identification pattern of the at least two conductive sense elements.

The '620 patent describes a fingerprint sensing device (100), which comprises a planar array of closely-spaced capacitive sense elements (120), that is operative to combine distance measurements (between the array of closely-spaced capacitive sense elements (120) and the ridges (180) and valleys (190) of a finger surface (160)) to produce a representation of the pattern of ridges (180) on the finger surface (160). The '620 patent does not teach or suggest that the array of closely-spaced capacitive sense elements (120) is configured to form binary-coded identification pattern as claimed in claim 42 of the instant application.

Nor does the '620 patent teach or suggest the use of a non-contact object having a binary-coded identification pattern that corresponds to the binary-coded identification pattern of capacitive sense elements. Rather, the '620 patent teaches a fingerprint sensing device (100) that is limited to use with fingers au naturel, i.e., the '620 patent does not teach or suggest that fingers be provided with a binary-coded identification system.

Rather, the '620 patent specifically teaches that the fingerprint sensing device (100) relies upon the natural uneven configuration of a finger surface, i.e., the ridges and valleys. The ridges and valleys of a finger surface are spaced closer to and farther from, respectively, the surface of the array of closely-spaced capacitive sense elements (120), where such distance differentials result in different capacitances for such ridges and valleys, respectively.

Finally, the Applicant respectfully controverts the Examiner's assertion that it would have been obvious to one skilled in the art to modify the invention of the '597 patent by the teachings of the '620 patent. The capacitive touch sensors of the '597 patent are separate and distinct sensors, each sensor being used to define a specific input, i.e., functionality, to a computer based upon a touch input to such sensor. The '597 patent does not teach or suggest that the capacitive touch sensors could be formed as an array, or that the outputs of the individual capacitive touch sensors could be combined. In fact, such a configuration and functionality would be contrary to the configuration and functionality described in the '597 patent, which is to provide separate and distinct outputs, via separate and distinct capacitive touch sensors, but if and only if such capacitive touch sensors have been touched. Accordingly, since the configuration and functionality of the capacitive touch sensors of the '597 patent are dissimilar from the configuration and functionality of the array of closely-spaced capacitive sense elements (120) described in the '620 patent, the Applicant respectfully submits that one skilled in the art would not have any reason or rationale to modify the invention of the '597 patent by the teachings of the '620 patent.

Based upon the foregoing discussion, the Applicant respectfully submits that independent claim 42, as amended, is patentably distinguishable over the cited references of record. Therefore, the Examiner is respectfully requested to reconsider the patentability of claim 42 in view of this discussion.

Based upon the foregoing, the Applicant respectfully submits that claims 1-14, 16, 18-34, 36, and 38-42 are patentably distinguishable over the cited references of record and in condition for allowance. The Examiner, therefore, is respectfully requested to reconsider the patentability and allowability of these claims in view of the foregoing.

Should any questions arise concerning this Preliminary Amendment, or the above-identified rule 53(b) continuation patent application, the Examiner is cordially invited to telephone the undersigned attorney of record.

Respectfully submitted,

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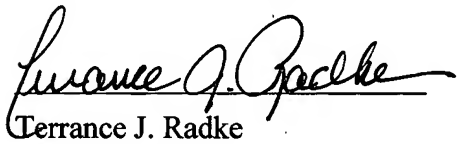

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